REMARKS

The Office Action dated March 29, 2004, was carefully reviewed. It is respectfully asserted that this response is being timely filed herein. Claim 4 is amended herein to unify the claims as suggested by the Examiner. Claims 1-14 remain in the application. It is respectfully requested the Examiner reconsider the present application in light of the remarks herein.

The Examiner rejected claims 1, 4-5, 8 and 11-12 under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 5,809,409 to Itoh et al., hereinafter Itoh, in view of U.S. Patent No. 6,549,763 to Imai et al., hereinafter Imai. The Examiner rejected claims 2-3, 6-7, 9-10, and 13-14 under 35 U.S.C. § 103 as being unpatentable over Itoh in view of Imai in further view of U.S. Patent No. 5,424,680 to Nazarathy et al., hereinafter Nazarathy. It is respectfully asserted that the present invention is patentable over the references cited by the Examiner.

The present invention is directed to the problem of spurious signals that occur in wireless communication on a satellite receiver. To overcome this problem the present invention proposes a new type of spur canceling using inexpensive filtering of second order harmonics close to a local oscillator frequency.

To accomplish this, the present invention teaches a subharmonic carrier-canceling baseband/K upconverter system using splitters, first and second subharmonic mixers, and a combiner to produce an RF output signal having reduced second order harmonics close to the local oscillator frequency.

Independent claims 1 and 8 of the present invention teach first and second splitters coupled to first and second subharmonic mixers that are coupled to a combiner that generates an output RF signal having reduced second order harmonics close to the local oscillator frequency. Independent claims 1 and 8 claim a first subharmonic mixer to mix I components of the input signal and the local oscillator, and a second subharmonic mixer to mix Q components. The Q component of the input signal is delayed by 180 degrees and the Q component of the local oscillator signal is delayed by 90 degrees.

Independent claims 4 and 11 of the present invention teach a first splitter whose first splitter Q signal is delayed 90 degrees behind the first splitter I signal, first and second subharmonic mixers, and a combiner for combining the mixer signals to generate an RF output signal having reduced second order harmonics close to the local oscillator frequency. Independent claims 4 and 11 claim a first splitter Q signal that is delayed by 90 degrees behind the first splitter I signal.

The Itoh reference is directed to the problem of several types of unwanted waves contained in the mixed waves that are the result of a mixer. According to Itoh, the conventional configuration of a balanced mixer creates a problem in that the suppression level of the unwanted waves appearing in the vicinity of a desired output wave frequency is small, due to a lower phase accuracy on the opposite-phase distribution by the 180 degree distributer. Itoh proposes a balanced mixer that suppresses the types of unwanted waves that cannot be

filtered when the output frequency is relatively lower than the local oscillation wave frequency.

The Itoh reference teaches a balanced mixer having a plurality of mixers, a distributer to effect different phase changes on the signal waves to be distributed among the plurality of mixers, a plurality of wave rejection means, and a combiner for first phase-shifting, then combining a plurality of mixed waves from which the unwanted signal waves have been removed.

Itoh teaches a first distributer (4 in Figure 1) that opposite phase shifts the input signal, as by 180 degrees. The phase-shifted signal is then passed, along with a local oscillator input, through unit mixers (2a and 2b in Figure 1) and through band rejection filters (16a and 16b in Figure 1). The signals are then combined in a combiner (6 in Figure 1) that provides the output signal. At column 8, lines 30-39, Itoh teaches in-phase distribtuion of the local oscillation waves to the respective unit mixers. Again at column 15, lines 26-28, Itoh teaches a local oscillation wave is supplied via the local oscillation wave input terminal 3 is in-phase distributed to the unit mixers 2a and 2b.

The Examiner identifies that the Itoh reference does not teach a second splitter separating the local oscillator signal into I and Q components where the Q component is delayed. Itoh teaches away from modifying the local oscillator input and teaches applying the local oscillator signals in-phase to the mixers.

The Examiner asserted that the Imai reference discloses an apparatus for preventing second order harmonic interference having a splitter for receiving I

and Q signals from a local oscillator, in which the Q signal is delayed 90 degrees behind the I signal and that it would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify Itoh to have a second splitter as per Imai, because it prevents second order harmonic interference.

The Imai reference is directed to a receiving apparatus that can receive and detect I and Q component signals of a digital modulated wave. The apparatus taught in Imai is designed to receive a digital modulated wave and includes an orthogonal detector, which detects an I-component signal and a Q-component signal of the digital modulated wave. Imai discloses a prior-art detector in the background of the invention.

The detector Imai discloses includes a mixer 11 that multiplies the signal from an attentuator 10 by a signal outputted from an oscillator 18, and outputs a resulting signal to a baseband amplifier. The amplifier 13 outputs the amplified signal into a low-pass filter 15 where the I-component signal is output. Mixer 12 multiplies a signal from the attenuator 10 that has been phase shifted by 90 degrees. The output goes to a baseband amplifier 14 and on to low-pass filter 16 where the resulting Q-component is output.

Referring again to the Itoh reference, it is respectfully asserted that there is no motivation to combine Itoh and Imai as suggested by the Examiner because Itoh teaches away from modifying the local oscillator input and does not teach or suggest including a second splitter separating a local oscillator signal into I and Q components whose Q signal is delayed 90 degrees behind the I signal.

According to claims 1 and 8 of the present invention, the first splitter separates the incoming RF signal into two equal components, I and Q 180 degrees delayed, and a second splitter to separate a local oscillator signal into two equal components I and Q 90 degrees delayed. A first mixer combines both I components and a second mixer combines both Q components. The output of both mixers is then combined. Claims 4 and 11 claim delaying the first splitter Q signal by 90 degrees behind the I signal.

Itoh teaches, at column 8, lines 30-39, in-phase distribution of the local oscillation waves in order to ensure the n-degree harmonics of the local oscillation waves will be in-phase with another and suppressed when combining the mixed waves in the combination means. And further, at lines 47-51, Itoh teaches that due to the in-phase distribution of the local oscillation wave, no influence of the phase error will be exerted on the n-degree harmonics of the local oscillation wave, among the waves output from the mixer. Also, in-phase distribution of the local oscillation wave is discussed at column 15, beginning at line 43.

Imai teaches a detector having the Q signal delayed 90 degrees behind the I signal for detecting the I and Q components of the incoming digital wave. There is no suggestion to combine the references as suggested by the Examiner. In fact, Itoh teaches away from modifying the local oscillation input in any way and, therefore it is asserted that one skilled in the art at the time of the present invention would not look to Itoh and Imai to include a second splitter signal from

the local oscillator input whose Q output is delayed behind the I output as taught by the Applicants of the present invention.

Because it is asserted that independent claims 1, 4, 8 and 11 are patentable over the Itoh and Imai references, it is asserted that the claims that depend therefrom are also patentable over the Itoh and Imai references. Therefore combining Itoh and Imai with Nazarathy et al. would not result in claims that depend from claims 1, 4, 8 and 11.

It is respectfully requested that the Examiner withdraw the rejection of claims 1-14 under 35 U.S.C. § 103.

Should the Examiner have any questions or comments, he is respectfully requested to call the undersigned attorney.

Respectfully submitted,

Angela M. Brunetti (ECO)

Angela M. Brunetti
Reg. No. 41,647

Attorney for Applicant(s)

Date: June 24, 2004

Artz & Artz, P.C.
28333 Telegraph Road, Suite 250
Southfield, MI 48034
(248) 223-9500
(248) 223-9522 fax